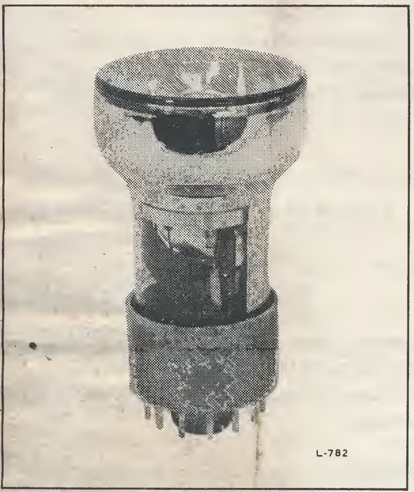

L-782

3"-Diameter, 10-Stage, Bialkali Photocathode Type Having a "Teacup" First Dynode

- **High Sensitivity Bialkali Photocathode**
- **Typical Pulse Height Resolution:**
  Cs^{137} source, NaI(T1) scintillator — 7.5%
  Co^{57} source, NaI(T1) scintillator — 10.6%
- **Typical Mean Gain Deviation:**
  For 26 weeks at 10,000 cps — 1%

RCA 4900 is a 3"-diameter, 10-stage head-on type of photomultiplier designed primarily for use in scintillation counting applications and in photometric low-light-level detection systems where a photomultiplier with a large photocathode area is required.

The 4900 employs a "teacup" first dynode followed by a hybrid box-and-grid/circular-cage dynode structure. The first dynode is similar in appearance to a truncated paraboloid. This structure affords increased efficiency in collecting photoelectrons from all areas of the useful photocathode with resulting improvements in pulse height resolution capability. The secondary emitting surface of all dynodes is beryllium oxide.

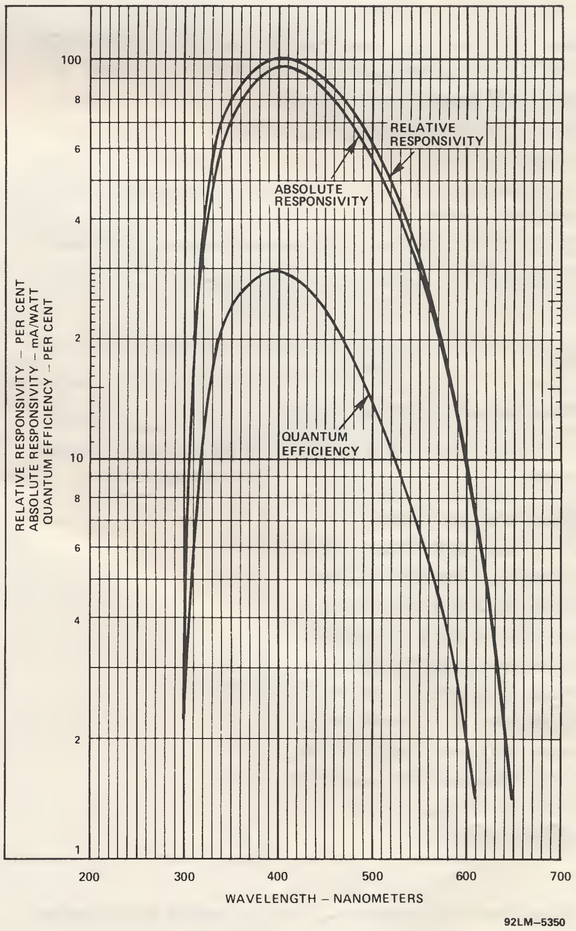


Figure 1 — Typical Photocathode Spectral Response Characteristics

General

Direct Interelectrode Capacitances (Approx.):

Anode to dynode No.10	5.0	pF
Anode to all other electrodes	3.5	pF
Operating Position	Any	

Maximum Ratings, Absolute-Maximum Values

DC Supply Voltage:

Between anode and cathode	1650	V
Between anode and dynode No.10	300	V
Between adjacent dynodes	300	V
Between dynode No.1 and cathode	600	V
Average Anode Current (Averaged over any 30 second interval)	0.5	mA
Temperature:		
Operating and storage	−100 to +85	°C

For further information or application assistance on this device, contact your RCA Sales Representative or write Phototube Marketing, RCA, Lancaster, PA 17604.

Printed in U.S.A./12-76

Characteristics Range Values for Equipment Design

Under conditions with the voltage distribution of Table I, a tungsten-filament light source at a color temperature of 2856 K, and an ambient temperature of 22° C, unless otherwise specified.

With E = 1350 V (Except as noted)

	Min.	Typ.	Max.	
Anode Responsivity:				
Radiant at 400 nm . . .	–	3.2×10^{4}	–	A/W
Luminous[a]	–	27	–	A/lm
Blue response[b]	1.5	3.5	15	A/incident lm
Cathode Responsivity:				
Radiant at 400 nm . . .	–	96	–	mA/W
Luminous[c]	–	81	–	µA/lm
Blue response[d]	10	10.5	–	µA/incident lm
Current Amplification (Gain)	–	3.3×10^{5}	–	
Anode Dark Current at 11.5 A/lm[e]	–	3×10^{-9}	3×10^{-8}	A
Equivalent Anode Dark Current Input	–	2.6×10^{-10}[f]	2.6×10^{-9}[f]	lm
	–	2.2×10^{-13}[g]	2.2×10^{-12}[g]	W
Pulse Height Resolution:[h]				
With Cs^{137} source, NaI(T1) scintillator[j] .	–	7.5	–	%
With Co^{57} source, NaI(T1) scintillator[k].	–	10.6	–	%
Mean Gain Deviation:[m]				
For a period of 26 weeks at a count rate of 10,000 cps . .	–	1	7.5	%
Anode Pulse Rise Time[n], at 1650 volts . . .	–	8.3×10^{-9}	–	s

Table I

Voltage to be Provided by Divider	
Between	**8.3% of Supply Voltage (E) Multiplied by**
Cathode and Dynode No.1	2
Dynode No.1 and Dynode No.2	1
Dynode No.2 and Dynode No.3	1
Dynode No.3 and Dynode No.4	1
Dynode No.4 and Dynode No.5	1
Dynode No.5 and Dynode No.6	1
Dynode No.6 and Dynode No.7	1
Dynode No.7 and Dynode No.8	1
Dynode No.8 and Dynode No.9	1
Dynode No.9 and Dynode No.10	1
Dynode No.10 and Anode	1
Anode and Cathode	12

a Anode luminous responsivity is calculated as shown below:

$$\text{Anode luminous responsivity (A/lm)} = \frac{\text{Anode blue response (A/incident lm)}}{0.13}$$

The value 0.13 is the average value of the ratio of the anode current measured under the conditions specified in footnote (b) to the anode current measured under the same conditions but with the blue filter removed.

b Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2856 K. The value of light flux incident of the filter is 1×10^{-5} lumen.

c This value is calculated as shown below:

$$\text{Cathode luminous responsivity (A/lm)} = \frac{\text{Cathode blue response (A/incident lm)}}{0.13}$$

The value 0.13 is the average value of the ratio of the cathode current measured under the conditions specified in footnote (d) to the cathode current measured under the same conditions but with the blue filter removed.

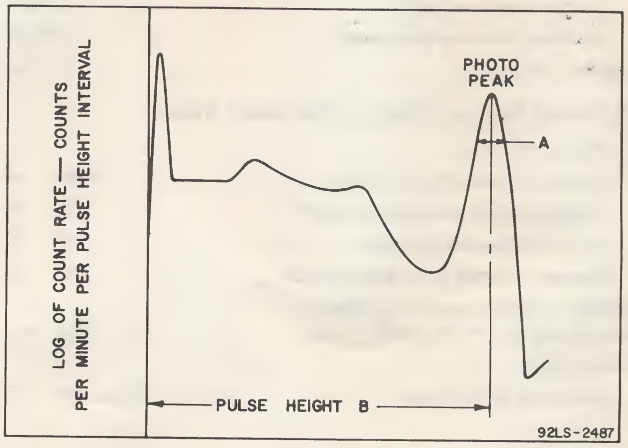
d Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2856 K. The light flux incident on the filter is 1×10^{-4} lumen and 300 volts are applied between cathode and all other electrodes connected as anode.

e At a tube temperature of 22° C. Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 1×10^{-5} lumen. The supply voltage E is adjusted to obtain an anode current of 15 microamperes. Sensitivity of the tube under these conditions is approximately equivalent to 11.5 amperes per lumen. Dark current is measured with no light incident on the tube.

f With supply voltage E adjusted to give an equivalent luminous responsivity of 11.5 amperes per lumen.

g At 400 nanometers.

h Pulse height resolution in per cent is defined as 100 times the ratio of the width of the photopeak at half the maximum count rate in the photopeak height (A) to the pulse height at maximum photopeak count rate (B).



j With a supply voltage of 1100 volts. The anode load is an RC network having a time constant of $10 \pm 2\ \mu s$. The 662 keV photons from a one-microcurie Cs^{137} source and an encapsulated 3"x3" diameter thallium-activated sodium-iodide scintillator [NaI(T1)] — Harshaw type 12A12, Serial No.HT35, or equivalent — are used. The Cs^{137} source is in direct contact with the metal end of the scintillator container. The faceplate end of the scintillator is coupled to the tube by a coupling fluid such as Dow Corning Corp. Type DC200 (Viscosity of 60,000 centistokes), or equivalent.

k Under the same conditions shown in footnote (j) except a Co^{57} radiation source is used. The intensity of the Co^{57} source is sufficient to produce between 5000 and 15,000 cps from the phototube. Pulse height resolution is defined as the fractional full-width at half-maximum of the 123 keV peak of the Co^{57} source.

m Under the same conditions shown in footnote (j) except the tube is operated with the Cs^{137} source located at a point providing a pulse count rate of 10,000 cps. After 24 hours of operation, the pulse height is sampled, at the specified count rate, at one-week intervals for a period of 26 weeks. Mean gain deviation is defined as follows:

$$MGD = \frac{\sum_{i=1}^{i=n} \left| \bar{p} - p_i \right|}{n} \cdot \frac{100}{\bar{p}}$$

where: $\bar{P}$ = mean pulse height
p_i = pulse height at the "i^{th}" reading
n = total number of readings

n Measured between 10 per cent and 90 per cent of maximum anode pulse height. Anode pulse rise time is primarily a function of transit time variation and is measured under conditions with the incident light fully illuminating the photocathode.

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN:	8.3% OF (E) MULTIPLIED BY
CATHODE AND DYNODE No. 1	2
EACH SUCCEEDING DYNODE	1
DYNODE No. 10 AND ANODE	1
ANODE AND CATHODE	12

THE PHOTOCATHODE IS FULLY ILLUMINATED.

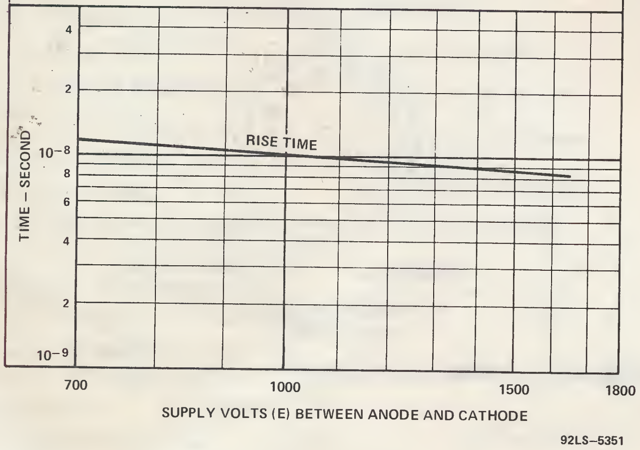


Figure 2 — Typical Time Response Characteristic

Operating Considerations

Anode Current

The operating stability of the tube is dependent on the magnitude of the average anode current.

The use of an average anode current well below the maximum rated value of 0.5 milliampere is recommended when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.

Cathode Current

An average cathode current of 1×10^{-9} ampere at a tube temperature of 22° C or 1×10^{-11} ampere at -100° C should not be exceeded. Because of the resistivity of the photocathode, the voltage drop caused by higher cathode currents may produce radial electric fields on the photocathode which can result in poor photoelectron collection by the first dynode. Photocathode resistivity increases with decreasing temperature.

Leakage Current

The application of high voltage, with respect to cathode, to insulating or other materials supporting or shielding the tube at the photocathode end should not be permitted unless such materials are chosen to limit leakage current to the tube envelope to 1×10^{-12} ampere or less.

In addition to increasing dark current and noise output because of voltage gradients developed across the bulb wall, such high voltage may produce minute leakage current to the cathode, through the tube envelope and insulating materials, which can permanently damage the tube.

Ambient Atmosphere

Operation or storage of this tube in environments where helium is present should be avoided. Helium may permeate the tube envelope and may lead to eventual tube destruction.

Anode-Dark Current

The tube is intended for use in systems requiring low dark current. Accordingly, the base of the tube should never be allowed to become contaminated by handling.

A temporary increase in anode dark current by as much as 3 orders of magnitude may occur if the tube is exposed momentarily to high-intensity ultraviolet radiation from sources such as fluorescent room lighting even though voltage is not applied to the tube. The increase in dark current may persist for a period up to 48 hours following such irradiation.

Warning — Personal Safety Hazards

Electrical Shock — Operating voltages applied to this device present a shock hazard.

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:	
BETWEEN:	8.3% OF (E) MULTIPLIED BY
CATHODE AND DYNODE No.1	2
EACH SUCCEEDING DYNODE	1
DYNODE No.10 AND ANODE	1
ANODE AND CATHODE	12

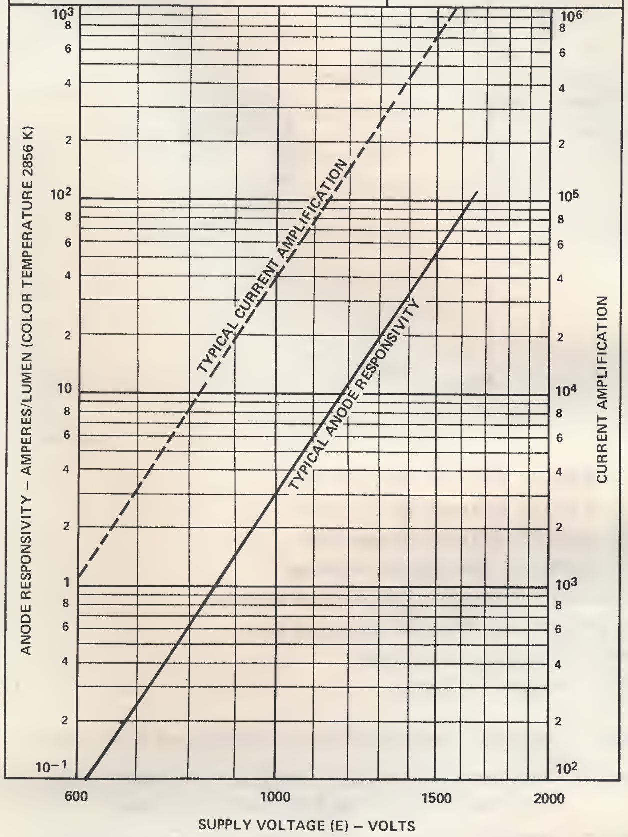


Figure 3 — Typical Current Amplification and Responsivity Characteristics

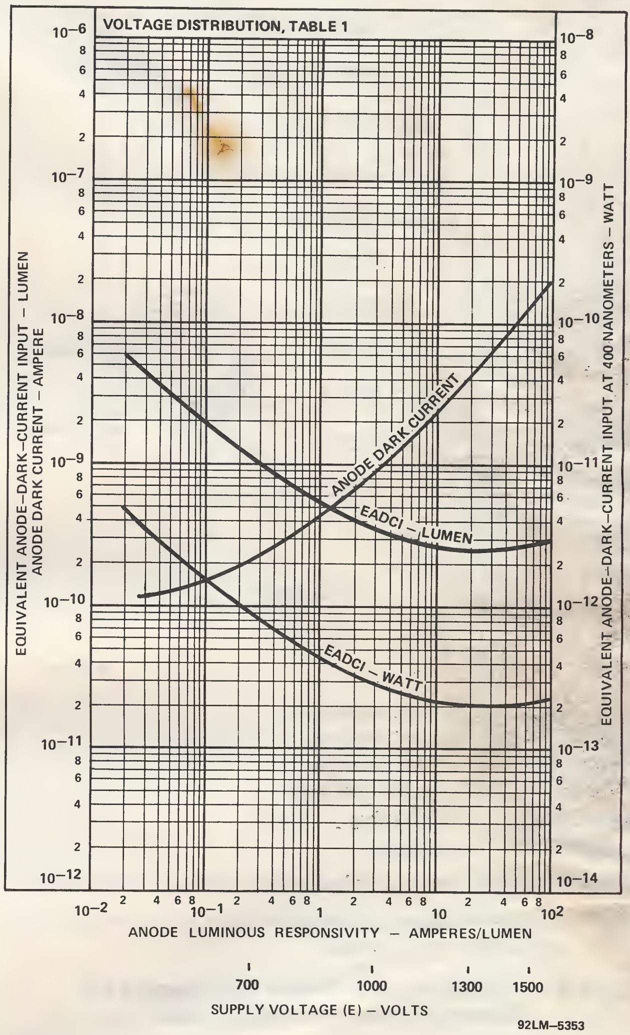
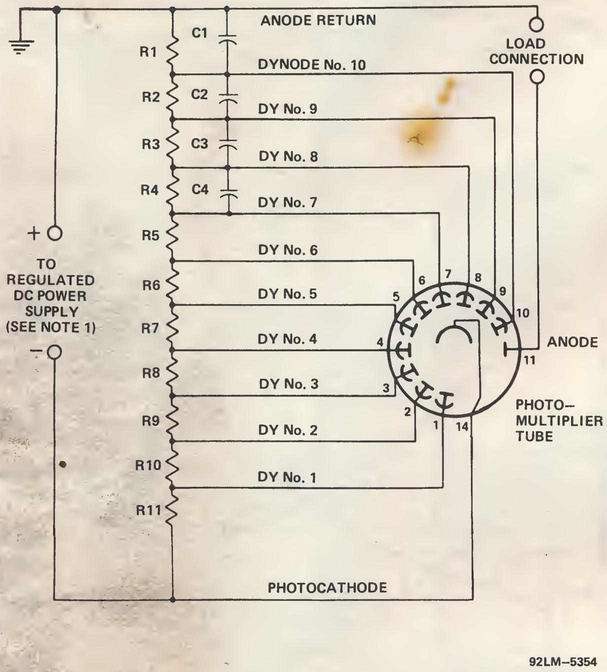


Figure 4 — Typical EADCI and Anode Dark Current Characteristics

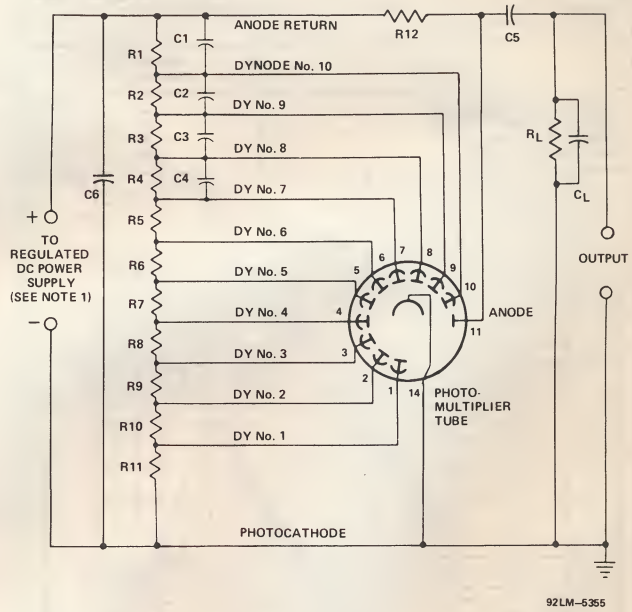


C_1: 0.05 μF, 500 volts (dc working)
C_2: 0.02 μF, 500 volts (dc working)
C_3: 0.01 μF, 500 volts (dc working)
C_4: 0.005 μF, 500 volts (dc working)
R_1 through R_{10}: 470,000 ohms, 1/2 watt
R_{11}: 910,000 ohms, 1/2 watt

Note 1: Adjustable between approximately 800 and 1650 volts dc.

Note 2: Component values are dependent upon nature of application and output signal desired.

Figure 5 — Typical Voltage Divider Arrangement for General Photometric Applications



C_1: 0.05 μF, 500 volts (dc working)
C_2: 0.02 μF, 500 volts (dc working)
C_3: 0.01 μF, 500 volts (dc working)
C_4: 0.005 μF, 500 volts (dc working)
C_5 and C_6: 0.005 μF, 3000 volts (dc working)
R_1 through R_{10}: 470,000 ohms, 1/2 watt
R_{11}: 910,000 ohms, 1/2 watt
R_{12}: 1 megohm, 1/2 watt

Note 1: Adjustable between approximately 800 and 1650 volts dc.

Note 2: Capacitors C_1 through C_5 should be connected at tube socket for optimum high-frequency performance.

Note 3: Component values are dependent upon nature of application and output signal desired.

Figure 6 — Typical Voltage Divider Arrangement for Scintillation-Counting Applications

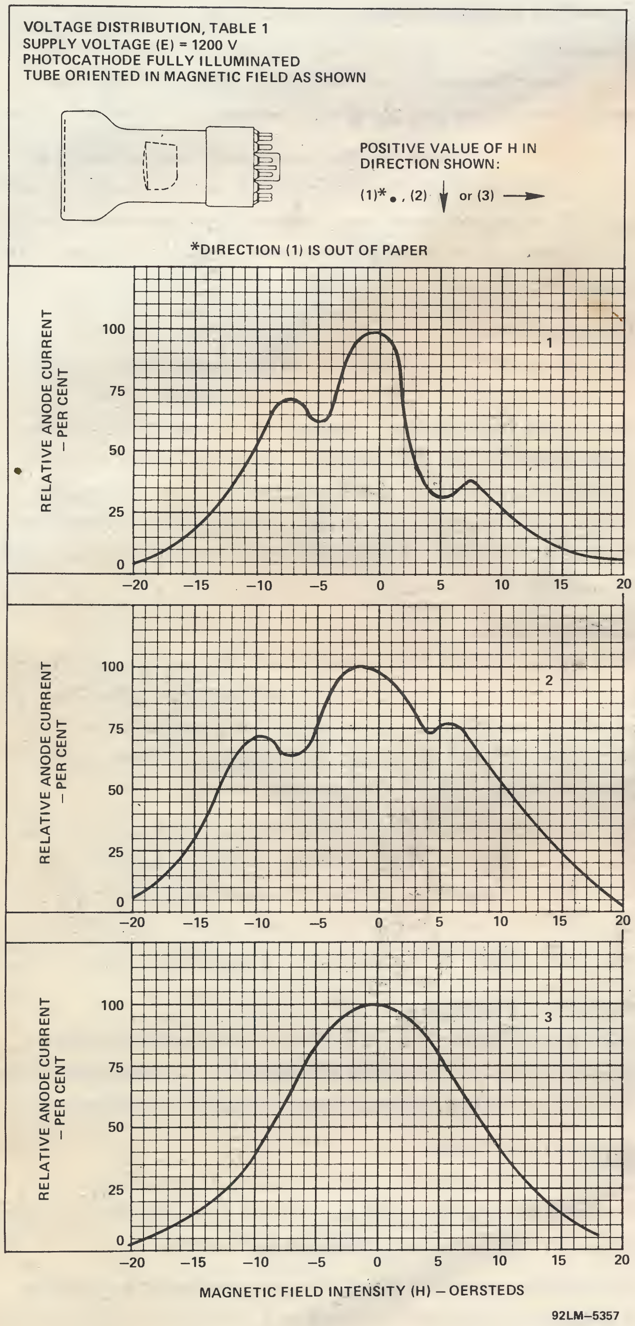
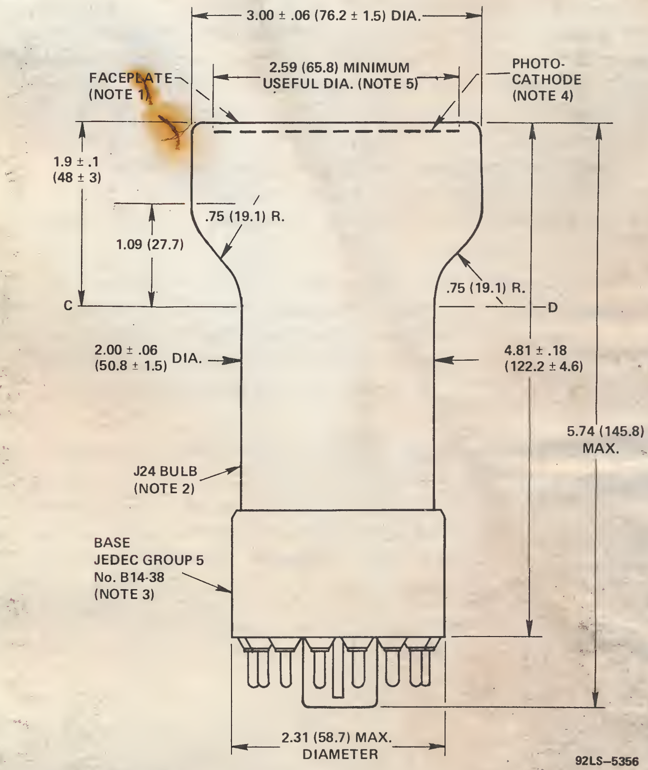


Figure 7 — Typical Effect of Magnetic Field on Anode Current



Approx. tube weight = 9 oz (255 g)
Dimensions in inches. Dimensions in parentheses are in millimeters.

Note 1: Faceplate material is Corning No.0080, or equivalent. Its index of refraction at 436 nanometers is 1.52.

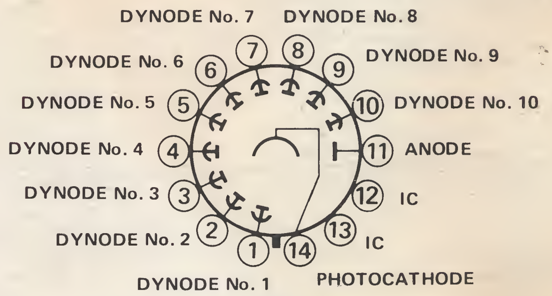
Note 2: A magnetic shield for this tube, RCA AJ2253, is available on request.

Note 3: A socket for this tube, RCA AJ2260, is available on request.

Note 4: Photocathode material is K-Cs-Sb.

Note 5: Within the 2.59″ diameter, deviation from flatness of the external surface of the faceplate will not exceed 0.010″ (0.25 mm).

Figure 8 — Dimensional Outline



IC = INTERNAL CONNECTION
DO NOT USE

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Figure 9 — Basing Diagram, Bottom View